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Douglas J. Mudgway



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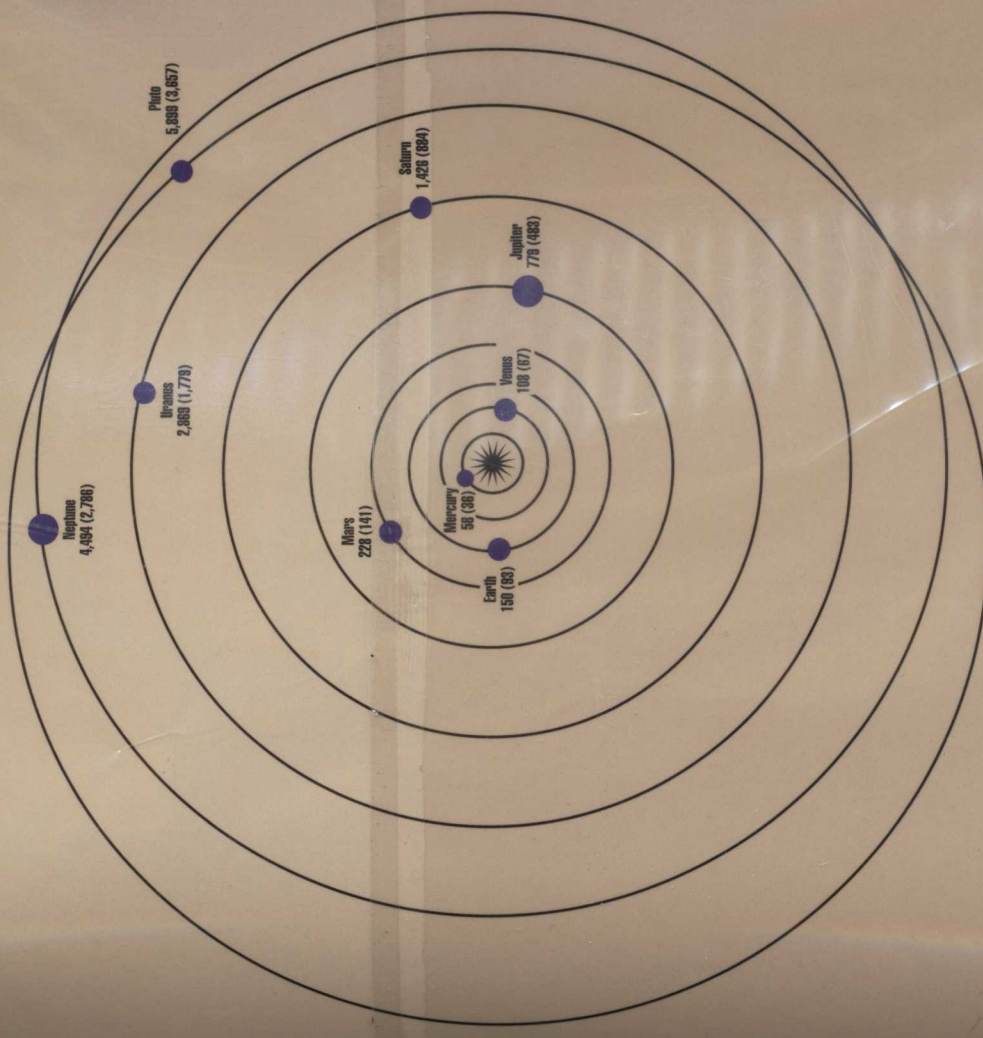
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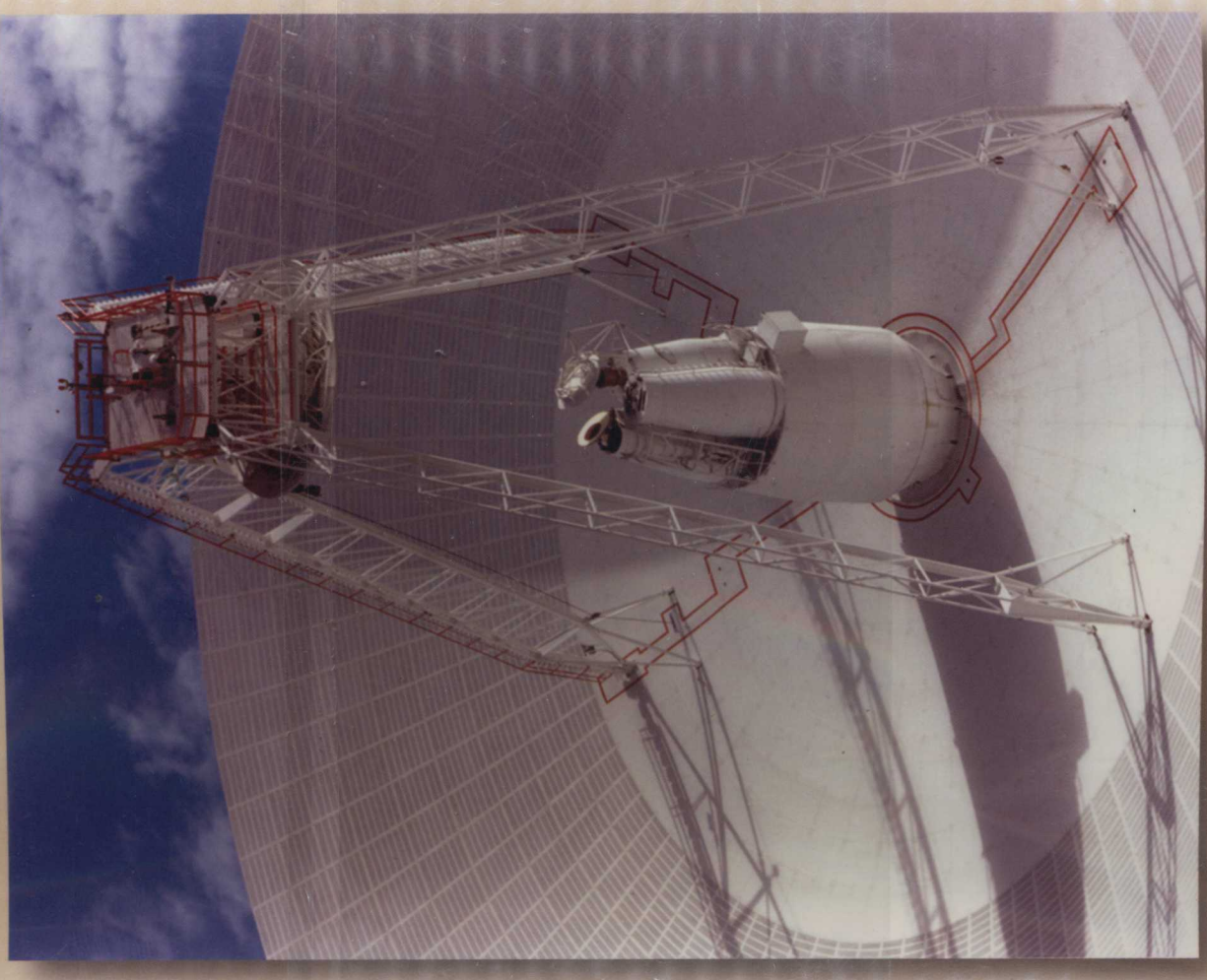


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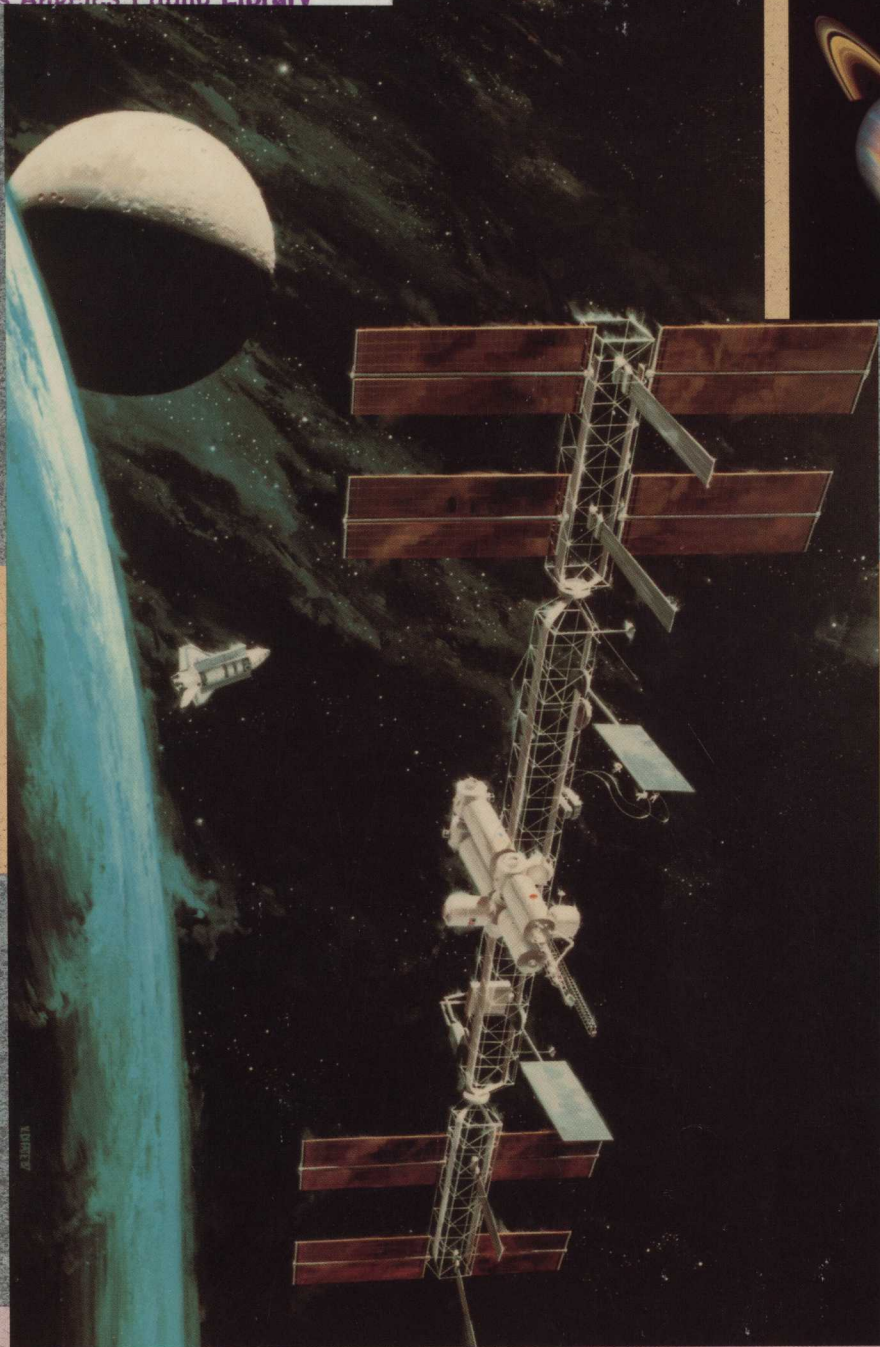


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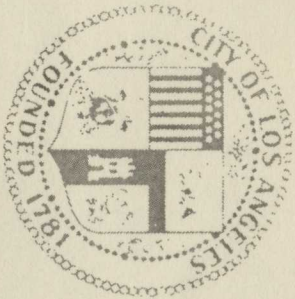
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VOYAGES TO SATURN

Voyages to Saturn



covering 10 hours of ring rotation. As they watched in fascination, the dark spoke-like features appeared and moved around the ring, changing shape as they went. The more the scientists saw these features, the more baffling they seemed. Torrence Johnson noted that, once again, our expectations had proved wrong. He said, "We never thought we would be able to see the rings spinning like this. When we planned the Saturn movie, we thought we would see the planet turning with the rings as a still life. It now appears to be more nearly the reverse."

With only a little more than a week to go until encounter, the pace at JPL was rapidly accelerating. Most of the participating scientists had arrived and occupied their offices. The press would soon follow. Many people realized that this would be the last opportunity for many years to participate in a major spacecraft encounter with an unknown world. Saturn, with its rings and satellites, lay spread before us. No one knew what discoveries might be made, but everyone was confident that the next 10 days would not be dull.

November 5, 1980 (9 million km)

The first formal science investigators meeting, chaired by Ed Stone, was held at JPL. At these daily meetings, the Principal Investigators for



each instrument would summarize their latest results and exchange ideas and tentative interpretations. Imaging Science Team Leader Brad Smith reported that the narrow F Ring appeared to be slightly eccentric, swinging about 400 kilometers farther from the planet on one side than the other. On the planet a wide variety of atmospheric features were being measured. These included bright halos surrounding dark centers, one long, dark feature similar to the so-called barges at Jupiter, intricately scrolled edges between belts and zones, and one confused spaghetti-like cloud. Perhaps most impressive were the unexpected numbers of belts and zones; in the southern hemisphere of Saturn between the ring and the pole, Smith counted 24.

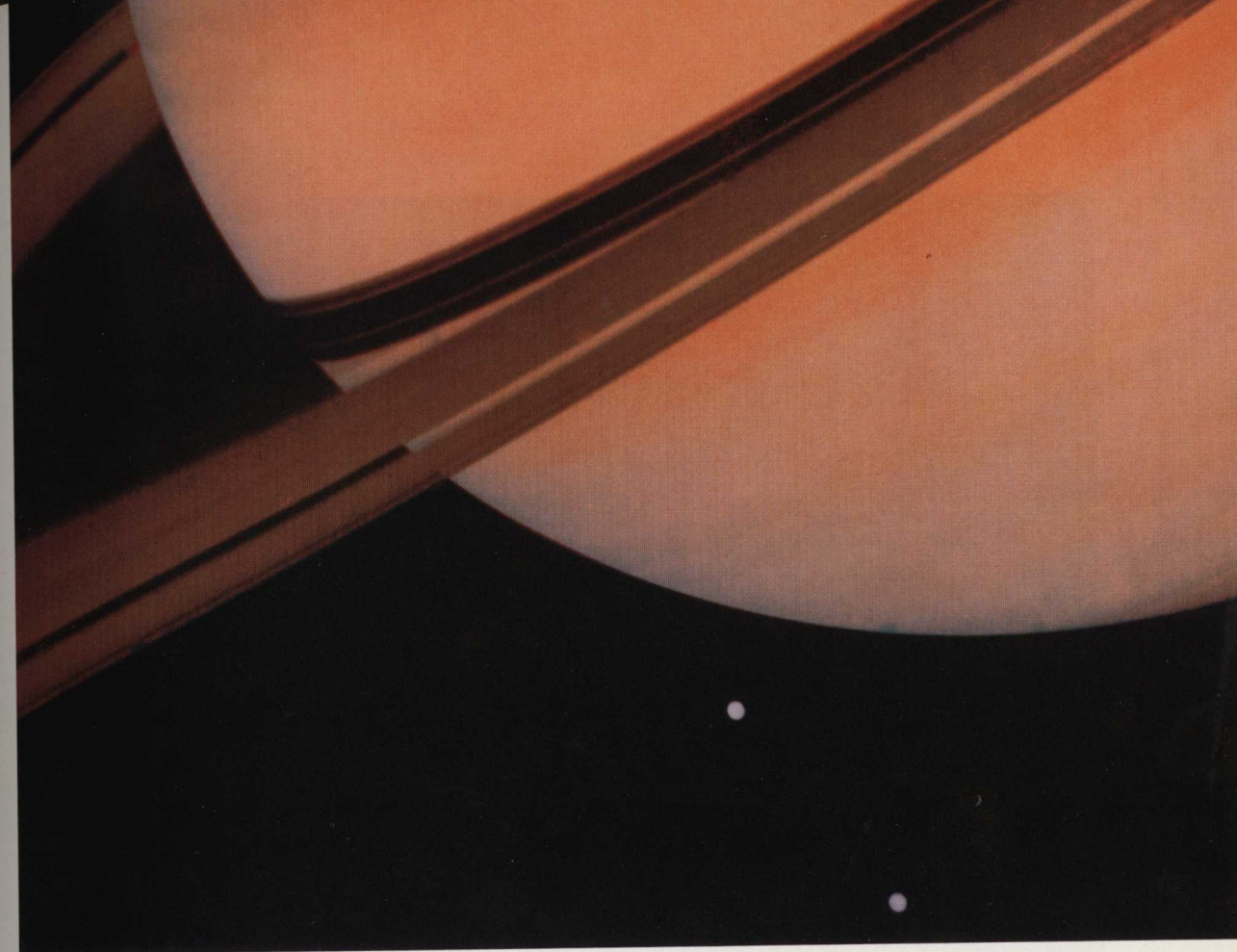
Lyle Broadfoot reported that the ultraviolet spectrometer was now obtaining spectra of Saturn showing a variety of emission lines, the strongest being Lyman α of hydrogen. In addition, several lines appeared at wavelengths between 80 and 160 nanometers. Although he could not provide individual identifications, Broadfoot noted that these probably represent atomic emission lines due to aurora in the atmosphere of Saturn.

Fred Scarf, reporting results from the planetary radio astronomy and plasma wave instruments, noted that in the past few days a new kind of radio radiation with a frequency of about 10 kilohertz had been observed. He believed that this radiation did not arise at the planet Saturn, but from Saturn's magnetosphere.

November 6, 1980 (8 million km)

Voyager was speeding up as it felt the gravitational tug of Saturn; the approach speed was now 15.4 kilometers per second. The far encounter sequence of observations continued with a major imaging mosaic on the rings once a day and observations of Titan with the full battery of remote sensing instruments once every six hours. Late in the evening searches were carried out for undiscovered satellites, and a long series of observa-

Magnetometer Principal Investigator Norm Ness examines a computer printout for indications that the Voyager spacecraft has reached the magnetosphere of Saturn. (P-23309BC)

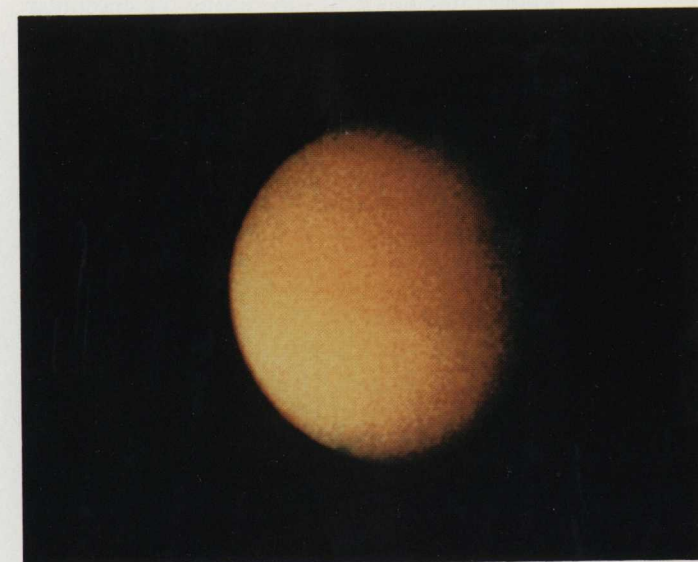


Silhouetted against the face of Saturn, the rings appear partly opaque and partly transparent. In this view, taken November 3 at a distance of 13 million kilometers, the A, B, and C Rings cast clearly separate, individual shadows on the cloud tops of Saturn. Also visible are two of the icy inner satellites, Tethys and Dione, as well as the black shadow of Tethys on the planet. (P-23058)

tions of Saturn were undertaken by the IRIS and the UVS. The resolution of the imaging cameras was now 150 kilometers.

At 10:30 a.m. the first news conference was held in Von Karman Auditorium at JPL. Project Manager Ray Heacock welcomed about 60

The large satellite Titan was the first main target of the Voyager 1 encounter. In this image, taken on November 9 from a distance of about 5 million kilometers, the cloud-shrouded satellite appears remarkably bland. However, a dark cap can be seen over the north pole, and there is a faint line along the equator separating the slightly darker northern hemisphere from the brighter southern hemisphere. There is no indication of any breaks in the clouds through which the surface might be glimpsed. (P-23076)

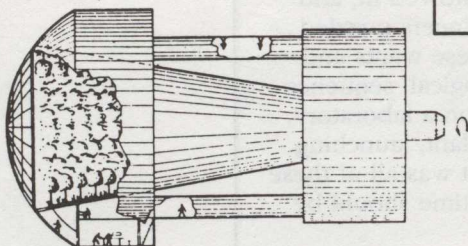


INTRODUCTION

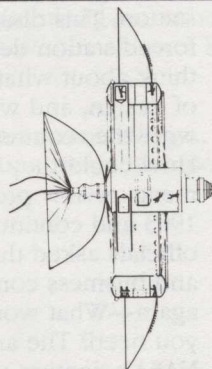
The Early Concepts

“The Earth is the cradle of the mind, but you cannot live in the cradle forever.”

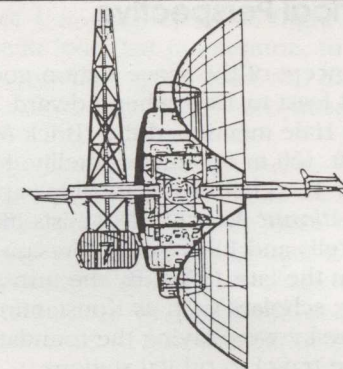
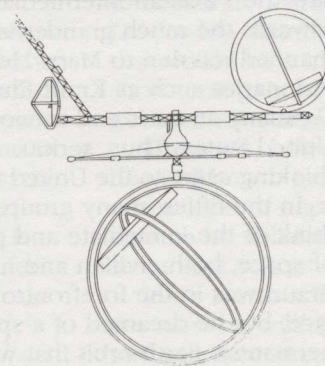
—Konstantin Tsiolkovsky



1900s
Konstantin Tsiolkovsky

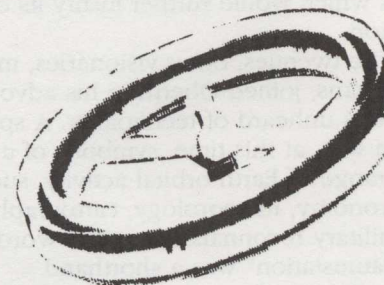


1920s
Hermann Noordung



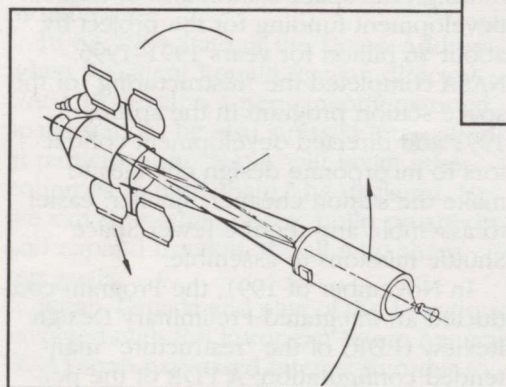
1940s
Harry E. Russ
and
Ralph A. Smith

1930s
Hermann Oberth

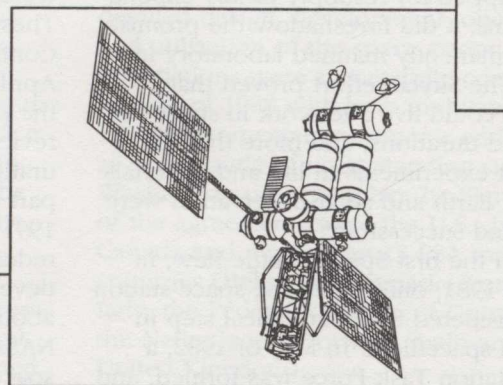


1950s
Wernher von Braun
and
Chesley Bonestell

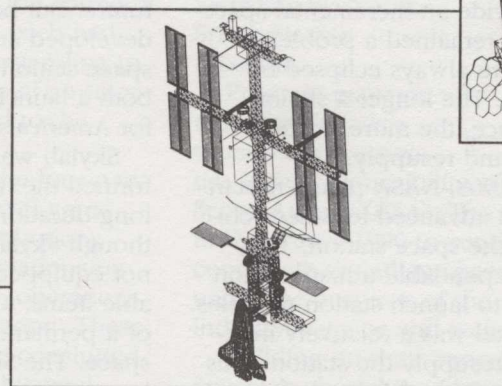
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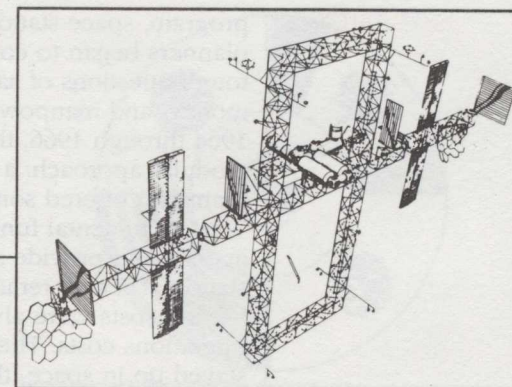
1960s
Spin/No Spin



1970s
Core Station



Early 1980s
Power Tower



Late 1980s
Dual Keel

"I t is difficult to say what is impossible;
for the dream of yesterday, is the hope
of today and the reality of tomorrow."

—Robert H. Goddard



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